Personalized Radiotherapy Planning Using AI

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ABSTRACT

Personalized radiotherapy planning using AI leverages machine learning and deep learning to optimize treatment for individual patients. By considering patient-specific tumor characteristics, adaptive planning, and dose optimization, AI enhances treatment precision and efficiency. This approach not only improves clinical outcomes but also ensures fairness, patient privacy, and interpretability in decision-making.

INTRODUCTION

- Traditional radiotherapy follows a generalized approach, often leading to variations in treatment effectiveness. AI-driven personalized radiotherapy tailors treatment based on tumor properties, ensuring a more targeted and effective response.
- Recent advancements, such as deep learning-based radiation sensitivity prediction, highlight AI's potential in optimizing therapy for lung cancer and beyond.

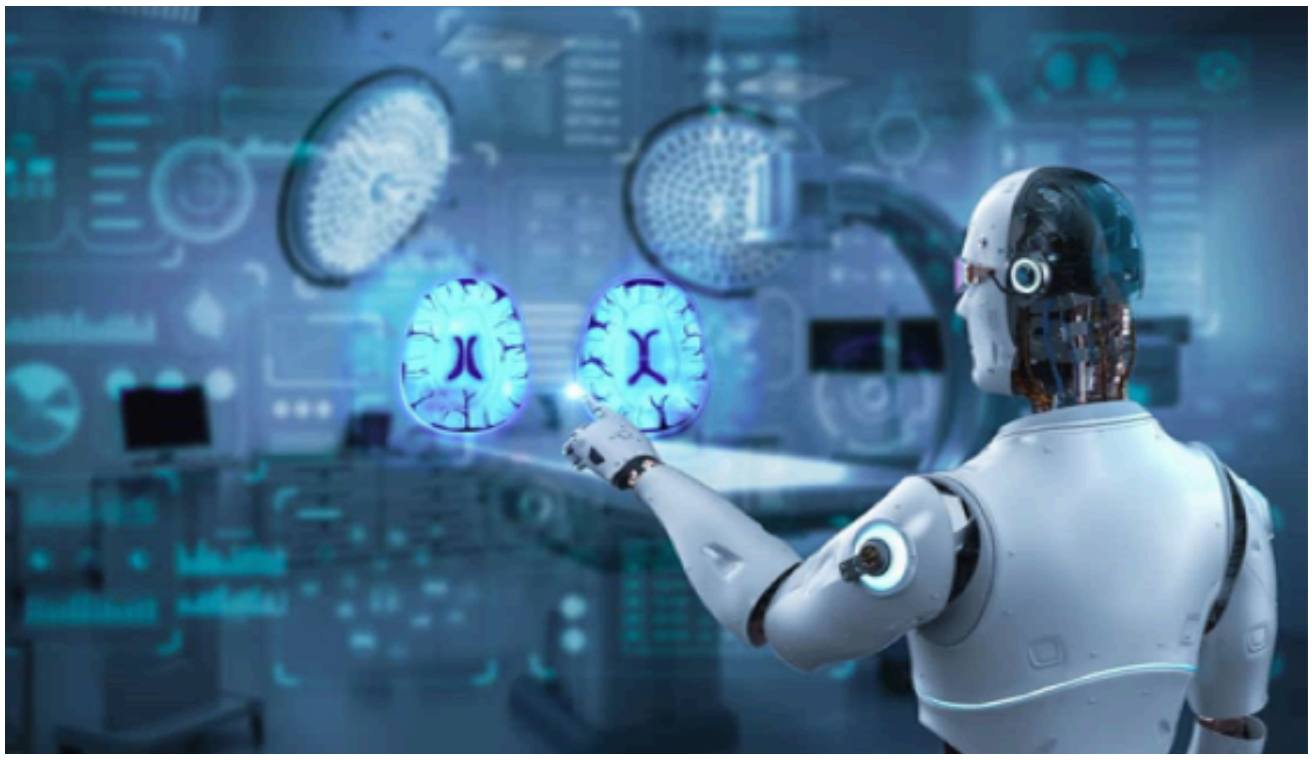

FIG 1.Implementation of AI in radiotherapy

METHODOLOGY

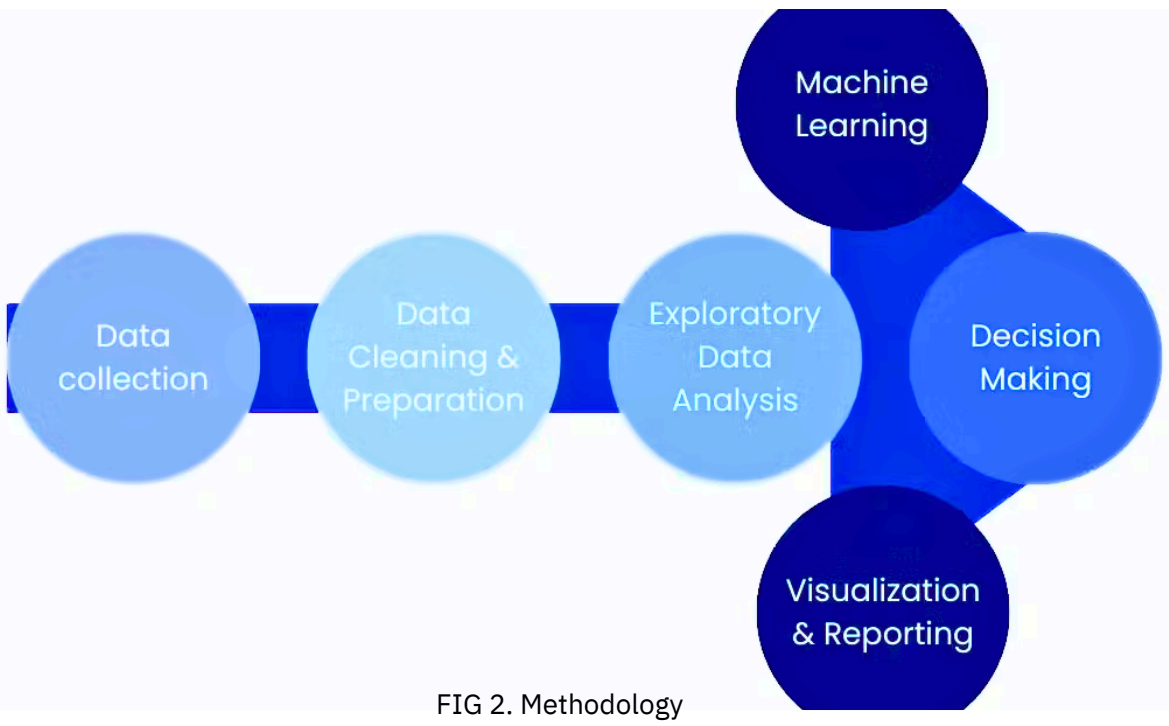

FIG 2. Methodology

LITERATUREREVIEW

AI in Radiotherapy: Studies highlight AI's role in contouring, treatment planning, and dose calculation.

Adaptive Planning: AI enables real-time adjustments based on tumor response.

Ethical Considerations: Ensuring fairness, transparency, and data security remains crucial.

Case Study: Cleveland Clinic's deep-learning network predicts radiotherapy outcomes using CT scans.

PRELIMINARY CONSIDERATIONS

Data Availability: Ensuring access to high-quality, diverse datasets for AI training

Regulatory Compliance: Adhering to legal frameworks for patient data protection

Clinician Acceptance: Developing AI tools that integrate seamlessly into medical practice

Bias Mitigation: Addressing algorithmic biases to ensure fair treatment across patient groups.

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EXPECTED RESULTS

- A radiotherapy dataset designed to evaluate both technical and human-centered aspects should include key parameters that reflect the effectiveness and usability of the developed approach.
- From a technical perspective, the dataset should contain patient demographics (age, gender, cancer type, tumor size), treatment details (radiotherapy type, dose distribution, fractionation scheme), medical imaging data (CT/MRI/PET scans with segmentation), and treatment outcomes (tumor response, toxicity levels, quality metrics). These elements help assess the accuracy, efficiency, and performance of the approach.
- On the human-centered side, the dataset should include patient-reported outcomes (PROs) such as pain levels, quality of life scores, and psychological impact before and after treatment.

REFERRENCES

- Early prediction of radiotherapy-induced parotid shrinkage and toxicity based on CT radiomics and fuzzy classification (Artificial Intelligence in Medicine, Volume 81,2017)
- The Clinical Development of Molecularly Targeted Agents in Combination With Radiation Therapy: A Pharmaceutical Perspective (International Journal of Radiation Oncology, Volume 84, Issue 4,2012)

CONCLUSIONS

AI-driven personalized radiotherapy enhances precision, efficiency, and patient outcomes while addressing ethical concerns. Future research should focus on improving AI transparency and ensuring fair treatment distribution. The integration of AI in radiotherapy marks a transformative step toward individualized cancer care.